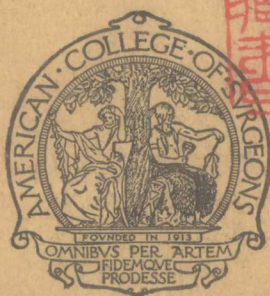


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An Outline of the

TREATMENT OF FRACTURES

BY THE COMMITTEE ON TRAUMA



AMERICAN COLLEGE OF SURGEONS

1949

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**THE TREATMENT OF
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BY THE COMMITTEE ON TRAUMA



Fourth Edition
Revised and Amplified

1949

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AMERICAN COLLEGE OF SURGEONS

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AN OUTLINE
OF THE
TREATMENT OF FRACTURES

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*Under authorization by the Board of Regents of the American College of Surgeons in March of 1949, on recommendation of the Committee, the name of the Committee was changed from Committee on Fractures and Other Traumas to Committee on Trauma.



Ray Taylor

1890-1947

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AN OUTLINE OF THE TREATMENT OF FRACTURES

FOREWORD

THE third edition of this Outline was issued in 1940. The present revision seems called for to bring the subject matter up to date in view of developments in the field of fracture treatment since that time. The Committee hopes that this fourth edition will be as favorably received as were the previous revisions. Numerous changes in text and illustration have been made, and in this edition the term "open" is used in place of "compound" and the word "closed" in place of "simple" in speaking of fractures.

No attempt has been made to describe the mechanics of the production of fractures, nor to give the technique of operative procedures, skeletal traction, or local anesthesia; such details may be found in appropriate publications. The fracture lesion and the process of repair following a fracture are described. The principles underlying the treatment of fractures are stated and a generally accepted form of treatment for certain fractures is outlined.

The Committee recognizes that the emergency initial treatment of a fracture is usually carried out by the general practitioner, who, in fact, often continues in charge of the individual patient. Delay in the treatment of fractures may be followed by serious consequences. Improper initial treatment may likewise be dangerous, and it is the hope of the Committee that this booklet will form a safe and ready reference manual for those who only occasionally are called upon to undertake the heavy responsibilities of the treatment of fractures. It may also find its way into the hands of students, interns, and house officers and serve as a useful outline of safe and modern methods. The treatment of difficult and complicated fractures, however, will always remain a field for skillful and experienced surgeons when such aid may be available.

The rapid increase in the number of automobile accidents has introduced a new factor and a new demand in the practice of physicians throughout the country. A great deal has been accomplished in the education of the public in the matter of first aid care of injured persons. Many members of police and fire departments, Boy Scouts, Girl Scouts, ambulance drivers, and others have received specific first aid instruction. Many first aid stations and ambulances now carry the equipment necessary for this treatment. It is the duty of every physician to support and advance this educational movement.

The Sub-Committee gratefully acknowledges the helpful suggestions made by various members of the Committee on Trauma.

GENERAL PRINCIPLES OF FRACTURE TREATMENT

THE FRACTURE LESION

The actual conditions at the site of the fracture are of great importance in establishing the general principles of treatment. They may vary from a simple crack in the bone and only the mildest disturbance of the surrounding tissue to a lesion of the greatest severity with marked displacement of the fragments and with much damage to all of the neighboring tissues. The best thing to do at the time the patient is seen will depend largely on the character of the bone lesion and the nature of the soft part damage as well as on the stage of pathological change present, that is, whether the patient is seen immediately after injury, early in the course of swelling and infiltration, later at the height of the inflammatory reaction, or days or weeks after the injury. Such problems, if they occur when no consultant is available, must be left to the judgment of the individual practitioner, to be handled as his skill and his equipment may dictate.

Ordinarily, when a bone is broken, the endosteum and the periosteum are torn and the surrounding soft parts are damaged to some extent. Blood vessels and lymphatics are ruptured and the tissues become infiltrated and engorged with blood, lymph, and exudate. This causes swelling, pain, and circulatory disturbance, all of which are increased by handling of the extremity and movements of the bone fragments.

The blood, lymph, and exudate rapidly form a fibrinous clot which begins to become organized in 48 hours. The bone ends at the fracture site and some of the soft tissues are killed by the trauma, and in their disintegration they yield ferments that break up the dead cells and calcium is removed from the dead and dying bone. The calcium is held in these tissues chemically by the fibrin derived from the exudate and hemorrhage. This process is slow and occupies several days. Later on this calcium is used in the formation of the callus at the fracture site.

The swelling and infiltration of the soft parts increase rapidly during the first 8 to 12 hours and by the end of this time the muscles and other soft parts have lost their elasticity and have become lardaceous, waterlogged, and inelastic. Reduction at this stage necessitates the use of more violence, is more difficult to accomplish, and results in more damage

Fracture Aphorism 1

Treat every case of injury as a fracture until it is proven to be otherwise. Protect and immobilize all injured patients until the diagnosis is made. "Splint 'em where they lie."

than if done earlier. Actual edema occurs as the result of circulatory disturbance due to pressure from swelling and thrombosis of vessels, even to the extent of bullae and blebs beneath the skin surface.

In addition to this common picture of the fracture lesion, there may be associated injuries to contiguous muscles, nerves, joints, tendons, tendon sheaths, and viscera which must be considered in both examination and treatment. The possibility of multiple fractures or of serious injury involving the head, chest, or abdomen should always be considered at the outset, and should be kept in mind throughout the patient's course.

Knowledge of the process of normal bone repair after fracture is important in interpreting the symptoms and signs presented by the patient.

1. Immediately after fracture has occurred, a period of local numbness and paralysis ensues during which time reduction is easily and almost painlessly accomplished. This period, which lasts from 5 to 20 minutes, represents the ideal time for reduction.

2. Swelling is associated with fracture. It normally increases for a period of 8 to 12 hours and should then slowly subside. Its presence must be taken into consideration in the tightness of application of splints and bandages. If the swelling is unduly rapid or large in amount, it indicates serious hemorrhage, and if in a region with tight fascial covering, there may be serious vascular complications. Under these conditions circulation must be checked carefully and frequently.

3. After 8 to 12 hours, exudation into the soft parts begins to organize and to form tissue which will later represent fibrosis in the soft parts. Measures that are designed to eliminate this condition must therefore be instituted before it has been transformed into fixed tissue.

4. As swelling proceeds, it represents fluid and exudate permeating the muscle and fascial planes and destroying their elasticity; therefore, accurate reduction is made more difficult and necessitates additional violence.

5. The extent and severity of the processes listed under 2, 3, and 4 are greatly increased by motion of the bone fragments and pain and spasm before reduction. The type of emergency splinting used is therefore important and is explained on page 7.

6. Ecchymosis is the discoloration of the skin due to chemical changes in the blood pigment. It represents seepage to the surface of the fluid portion of extravasated blood. If it appears extremely early and at the point of injury, it indicates extensive tearing of the tissues. If it appears late and at a distance from the fracture, it indicates seepage along normal tissue planes and relatively mild soft part damage.

7. Pain is the result of tension due to swelling and of movement of the bone fragments. Adequate immobilization and measures to minimize and reduce swelling are more effective in handling pain than is the mere use of sedatives or narcotics.

8. The attending physician should associate with every fracture certain definite and common nerve, vascular, tendon, or joint complications. The examination of the fracture should include automatically examination for these complications. X-ray films do not show them.

Fracture Aphorism 2

Always use gentleness and care in handling any broken limb.
Roughness is inexcusable.

9. When a fracture involves a joint, the hemorrhage into the joint cavity may be under great tension. This is productive of intense pain and restriction of motion. When this is the case, aspiration of the joint may provide relief from pain, and considerable increase in motion range. Joint aspiration, if done, must be carefully done under conditions of rigid asepsis.

10. When the patient is under an anesthetic, interposition of tissue can frequently be recognized by failure to get bony contact and crepitus. Its early recognition allows proper treatment instead of later operative procedures for the resultant nonunion.

11. Traction-suspension as a method of treatment requires recognition of pathology for adequate application. This is discussed under "Manual Traction and Traction-Suspension." (See page 14.)

HEALING OF FRACTURES

The actual mechanism whereby calcium is deposited in the tissues to form bone is unknown, as is the chemical form in which that calcium exists. But the rest of the process is sufficiently well established to give a definite idea of what happens. After the fracture lesion as previously described has appeared, the bone ends and the surrounding soft parts (soft parts of bone and extrasketal tissue which has undergone laceration) are bound together by the interlacing mesh of the fibrin from clotted blood, lymph, and exudate always present at the site of fracture. There is a certain amount of edema. Within a few hours fibroblasts appear in the fibrin clot and begin the formation of granulation tissue. The more fluid element that is present, the less effective and rapid is the cell proliferation. Within 48 hours this organization has proceeded to a considerable degree.

The cells forming this tissue are derived from the soft parts of the bone—endosteum, marrow reticulum, and periosteum; from the soft parts around the site of fracture; and from the lymphocytes infiltrating the part as a result of the cellular reaction. Within 72 to 96 hours this mass of cells, while loose meshed and friable, becomes an organized tissue uniting the ends of the bone and the adjacent soft parts. Unless there is infection or mechanical obstruction such as interposition of tissue, all fractures heal in this manner.

Calcium is deposited in the newly formed living tissue, which then constitutes early callus formation. The deposition of calcium has been observed as early as 72 hours in sections removed from actual fractures. The growing tissue is infiltrated with the calcium derived from autolyzed dead bone either in solution or in colloid state. The process then goes on to progressively denser concentration of deposited calcium until the callus becomes mature bone. With use and the action of normal stress and strain over a period of months, the bone arranges its lines and channels to form the normal histological picture of bone. It frequently takes a year or more for the completion of this process.

Fracture Aphorism 3

Use only the simplest methods of examination.

It is generally agreed that the healing process is local and that general conditions of disturbed metabolism or disease have little influence on its course. Nor does age seem to play any influential part, once adult life is reached. In children, however, the process of repair is more rapid and the probability of adequate bony callus more certain. Delay or failure of union except in the case of interposition of tissue between the bone ends is very unusual.

In the meantime the organization of granulation tissue proceeds in the fibrin mesh throughout the affected soft parts and becomes organized tissue within a week. The effectiveness and rapidity of growth of tissue is dependent upon efficient circulation in the parts from which the cells are derived, and, as stated above, is retarded and limited by excessive fluid exudate at the site of fracture. Therefore every effort must be made from the beginning to help the efficiency of the circulation.

Healing by granulation tissue takes place in all fractures except when mechanical obstruction exists between the fragments. Retarded deposition of calcium in the tissue produces so-called delayed union, whereas its absence produces so-called nonunion. Delayed union and nonunion are more apt to occur in certain bones and certain portions of these bones even when all other factors are equal. Certain sites of fracture in some bones are therefore characterized by a prolonged "healing time" as the usual and expected result. These regions are the ones in which circulation after injury is apt to be poor.

In addition to the other factors cited, the time needed for sufficient ossification in the healing process to allow function depends on what the function of the part calls for in the way of solidity. Thus the arm, which does not have to bear weight, can return to function sooner than the leg, which in addition to moving must be strong enough to bear weight; and the clerk can resume full function more quickly than the day laborer with the same fracture.

Taking into consideration all the factors referred to above, the following statements are clinical guides derived from the study of the healing process after fracture:

1. There is frequent difficulty with the healing process in certain regions of the body, notably in the subcapital and intracapsular portions of the femoral neck, the junction of the lower and middle thirds of the tibia, the proximal third of the carpal scaphoid, the lower third of the ulna, and the junction of lower and middle thirds of the humerus. These fractures, therefore, require prolonged immobilization time or special treatment, operative or otherwise, to increase the chances of union.

2. Advanced age, general disease, and general disturbance of metabolism should be considered as factors affecting the patient's chances of survival, not as factors interfering with the healing process.

3. Delayed union and nonunion are frequently the result of unduly violent or repeated attempts at reduction, inadequate reduction, insufficient and

Fracture Aphorism 4

Eliminate all unnecessary handling of the injured part.

too short-lived immobilization of bone fragments, and tight splinting or bandaging. Inadequate reductions and the necessity for violent and repeated attempts at reduction sometimes follow delay in reduction.

4. When functional disabilities are not caused by failure of union or bony deformity, or direct nerve or vascular lesions, they result from fibrosis in the soft parts due to organization of the condition produced therein at the time of fracture and intensified by prolonged or extensive immobilization of joints and muscles. They can be minimized by early removal of as much of the condition as possible through physical therapy in the first ten days, by as little immobilization of joints and muscles as is possible without interfering with the immobilization of the bone fragments, and by as much active exercise of joint and muscle as can be obtained throughout the course of the healing of the fracture. In any given case the method or methods which most nearly carry out these requirements will produce the best convalescence and the better functional end results.

FIRST AID

The injuries resulting from fractures are not limited to those occurring at the time of the accident. Unwise attempts to use the injured extremity may cause or increase displacement of fragments, increase the lacerations of soft parts, and perhaps lead to penetration of the skin by the ends of the bone. Similar additional trauma is often due to the awkward efforts of the bystander. A man is struck by an automobile and his leg is broken. Except for the broken bone, without displacement, the original injury may be merely a slight periosteal tear and a mild contusion of the soft parts, but he is helped to his feet, the leg gives way, and the fragments slide by each other, thus stripping off the periosteum and tearing the muscles. He falls to the ground only to be picked up and carried to the sidewalk with the leg dangling. Larger blood vessels are torn and the end of the bone comes through the fascia, perhaps the skin and even the trouser. He is laid at rest with a coat beneath his head and surrounded by people anxious to help. Someone sees that his leg is crooked and straightens it out. The exposed end of the bone re-enters the wound with a bit of trouser and the dirt of the street. He is lifted up and carried to a car or ambulance. This time someone carries the injured leg with better intentions than co-ordination, and the ends of the bone are churned around in their bed of lacerated tissues and the contaminating organisms are well disseminated throughout the area. During his ride and in the transfer to the accident ward or the doctor's office there is more jolting and more damage unless he has been carefully splinted. Would that his troubles were over, but too often the sad story continues. Lack of sufficient protection as he is lifted to and from the x-ray table and as he is being anesthetized results in still more injury.

Compare this exaggerated picture with a similarly injured man who is allowed to remain where he is until a proper splint can be applied, or at

Fracture Aphorism 5

Never deliberately search for crepitus.